

SOUTHWEST FISHERIES SCIENCE CENTER
FIRST QUARTER REPORT-FY 2003
For the Period October 1 - December 31, 2002

- 1. Submitted by:** John R. Hunter, Division Director, Fisheries Resources Division.
- 2. Title of accomplishment:** Acoustical estimation of zooplankton and fish abundance in relation to marine mammals
- 3. Current status:** Completed
- 4. Background information:** Two large-area surveys of marine mammals (ORCAWALE 01 and HICEAS 02) were recently conducted off the west coast of the U.S.A. and in the Hawaiian EEZ. The main objectives of these surveys were to estimate the abundances and distributions of dolphins and whales commonly found in those waters. Additionally, biological and oceanographic studies were conducted to characterize their environment and the biotic and abiotic interrelationships.
- 5. Purpose of activity:** Acoustically estimate the distribution and relative abundance of potential marine mammal prey off the west coast of the United States of America during the ORCAWALE 01 cruise, and in the exclusive economic zone of the Hawaiian Islands during the HICEAS 02 cruise.
- 6. Description of accomplishment and significant results:** Information regarding the distribution and abundance of fish and krill in the two survey areas were obtained through the collection and analysis of multi-frequency echosounder data. The Advanced Survey Technologies Program (AST) of the SWFSC's Fisheries Resources Division (FRD), in conjunction with the U.S. AMLR Program, has developed multi-frequency techniques for acoustical identification and delineation of sound scatter from various taxa. These techniques were applied to these surveys to map the distributions of whale forage and other related species.

On the NOAA ship *David Starr Jordan*, acoustic volume backscatter coefficients (sv) were logged continuously from the Simrad EK500 echosounder operating at 38, 120, and 200 kHz. The sv at each frequency were logged for each ping (2 Hz repetition rate) from the surface to 500 m using SonarData's EchoLog_EK software. The multifrequency data were post-processed using SonarData's EchoView software. To identify backscatter from fish versus zooplankton, differences in mean volume backscatter strengths ($Sv_{200\text{ kHz}} - Sv_{38\text{ kHz}}$; where $Sv = 10\log(sv)$) were used to mask the echograms. The Sv-difference bins for each taxa were determined empirically and confirmed theoretically using physics-based scattering models for fish and euphausiids. The sv from each taxa were integrated from 10 to 500 m and averaged over 1 n.mi. distances (nautical area scattering coefficient or NASC) and plotted as distribution maps (see Figure 1 for west coast maps). These NASC are thought to be roughly proportional to the biomass of each taxa. The data collection and processing were similar to the methods detailed in Hewitt and Demer (1993) and Hewitt *et al.* (2002).
- 7. Significance of accomplishment:** The EK500 acoustic backscatter provided effective observational ranges in excess of 500 m at 38 kHz, 225 m at 120 kHz and 175 m at 200 kHz. In both surveys, the locations of the fish and zooplankton appeared to be strongly associated with shallower bathymetry. Off the west coast of the U.S.A., highest densities of each taxa were mapped shoreward of the 4000 m contour. Both fish and zooplankton were highest in the Southern California Bight, and in the coastal areas of northern California and Oregon. A diel pattern showing higher NASC during nighttime hours was stronger for fish than zooplankton. At night, the observed fish occupy the whole water column; during the day they stay closer to the sea-surface. An extensive seventy-eight page report of this analysis has been drafted. These prey-data are to be correlated with marine mammal distributions, and investigated as possible forcing functions for dynamics in whale and dolphin distributions and abundances.
- 8. Problems:** None
- 9. Contact:** David Demer (858-546-5603); david.demer@noaa.gov

Literature Cited

- Hewitt, R.P. and D. A. Demer. 1993. Dispersion and abundance of krill in the vicinity of Elephant Island in the 1992 austral summer. *Mar. Ecol. Prog. Ser.* 99: 29-39.
- Hewitt, R. P., J.L. Watkins, M. Naganobu, P. Tshernyshkov, A.S. Brierley, D.A. Demer, S. Kasatkina, Y. Takao, C. Goss, A. Malyshko, M.A. Brandon, S. Kawaguchi, V. Siegel, P.N. Trathan, J.H. Emery, I. Everson and D.G.M. Miller, 2002. Setting a precautionary catch limit for Antarctic krill. *Oceanography*. 15(3): 26-33.

Figure 1. Integrated volume backscattering coefficients (NASC; $\text{m}^2/\text{n.mi.}^2$) thought to be associated with fish (a), and zooplankton (b) during ORCAWALE, *David Starr Jordan*, 30 July – 10 November 2001.

